

CLAIMS.

1. A silicon implant having a beneficial substance associated with it, the implant being eroded when implanted in a mammalian body.
2. A silicon implant according to claim 1 in which the implant comprises porous silicon.
3. A silicon implant according to claim 1 which comprises polycrystalline silicon.
4. A silicon implant according to ~~any preceding claim~~ ^{claim 1} which is resorbed when implanted in a mammalian body.
5. A silicon implant according to ~~any preceding claim~~ ^{claim 1} which if left in the mammalian body for long enough is substantially completely resorbed.
6. A silicon implant according to ~~any preceding claim~~ ^{claim 1} in which said beneficial substance comprises an element of the periodic table.
7. A silicon implant according to claim 6 in which the element is a micromineral.
8. A silicon implant according to claim 7 in which the micromineral is from the group: selenium, manganese, molybdenum, chromium, vanadium, iodine, fluorine, cobalt (vitamin B12).
9. A silicon implant according to claim 6 in which the element is an essential trace element identified as such in Figure 5.

Omnibus

Table 1

Parameter	Value
α_1	0.01
α_2	0.01
β_1	0.01
β_2	0.01
γ_1	0.01
γ_2	0.01
δ_1	0.01
δ_2	0.01
ϵ_1	0.01
ϵ_2	0.01
ζ_1	0.01
ζ_2	0.01
η_1	0.01
η_2	0.01
θ_1	0.01
θ_2	0.01
ϕ_1	0.01
ϕ_2	0.01
χ_1	0.01
χ_2	0.01
ψ_1	0.01
ψ_2	0.01
ω_1	0.01
ω_2	0.01
ν_1	0.01
ν_2	0.01
μ_1	0.01
μ_2	0.01
λ_1	0.01
λ_2	0.01
κ_1	0.01
κ_2	0.01
ι_1	0.01
ι_2	0.01
\jmath_1	0.01
\jmath_2	0.01
\mathfrak{h}_1	0.01
\mathfrak{h}_2	0.01
\mathfrak{k}_1	0.01
\mathfrak{k}_2	0.01
\mathfrak{l}_1	0.01
\mathfrak{l}_2	0.01
\mathfrak{m}_1	0.01
\mathfrak{m}_2	0.01
\mathfrak{n}_1	0.01
\mathfrak{n}_2	0.01
\mathfrak{o}_1	0.01
\mathfrak{o}_2	0.01
\mathfrak{p}_1	0.01
\mathfrak{p}_2	0.01
\mathfrak{q}_1	0.01
\mathfrak{q}_2	0.01
\mathfrak{r}_1	0.01
\mathfrak{r}_2	0.01
\mathfrak{s}_1	0.01
\mathfrak{s}_2	0.01
\mathfrak{t}_1	0.01
\mathfrak{t}_2	0.01
\mathfrak{u}_1	0.01
\mathfrak{u}_2	0.01
\mathfrak{v}_1	0.01
\mathfrak{v}_2	0.01
\mathfrak{w}_1	0.01
\mathfrak{w}_2	0.01
\mathfrak{x}_1	0.01
\mathfrak{x}_2	0.01
\mathfrak{y}_1	0.01
\mathfrak{y}_2	0.01
\mathfrak{z}_1	0.01
\mathfrak{z}_2	0.01

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10. A silicon implant according to claim 6 in which the element is a therapeutic element.

11. A silicon implant according to claim 10 in which the element is from the group: ^{consist of} lithium, gold, silver, platinum.

12. A silicon implant according to ~~any preceding claim~~ ^{Claim 1} in which the substance is distributed through a volume of the material of said implant.

13. A silicon implant according to claim 11 in which the substance is distributed through substantially the whole volume of the material of the implant.

14. A silicon implant according to ~~any preceding claim~~ ^{Claim 1} which comprises at least a region of porous silicon.

15. A silicon implant according to ~~claim 14~~ ^B which comprises substantially entirely porous silicon.

16. A silicon implant according to ~~claim 14 or claim 15~~ ^{Markush: 1 within} which has a porosity of at least 3%, 4% or 5%.

17. A silicon implant according to ~~any one of claims 14 to 15~~ ^{Claim 14} which has a porosity of 30% or less.

18. A silicon implant according to ~~any one of claims 14 to 16~~ ^{Claim 14} which has a porosity in the range 3% to 10%, or in the range 10% to 60%. ^{within}

19. A silicon implant according to ~~any preceding claim~~ ^{Claim 1} in which there is provided a reservoir of beneficial substance, and a door leading to the

reservoir, the door being made of silicon material which is corroded in use so as to enable body fluid to contact the beneficial substance in the reservoir.

20. A silicon implant according to claim 19 in which there are a plurality of reservoirs.

21. A silicon implant according to claim 19 ~~or claim 20~~ in which the reservoirs are adapted to expose or release their contents to body fluids sequentially with time.

22. A silicon implant according to *claim 19* ~~any one of claims 19 to 21~~ in which there are a plurality of reservoirs, each having an associated door, and in which there are doors of different corrosion times, such that in use the reservoirs are breached at different times.

23. A silicon implant according to *B* ~~claim 22~~ in which there are doors of different thicknesses.

24. A silicon implant according to claim 22 in which there are doors which corrode at different rates.

25. A silicon implant according to *claim 19* ~~any one of claims 19 to 24~~ in which there is an array of reservoirs.

26. A silicon implant according to *claim 19* ~~any one of claims 19 to 25~~ in which the reservoirs comprise holes which contain the beneficial substance.

27. A silicon implant according to *claim 19* ~~any one of claims 19 to 25~~ in which the reservoirs comprise regions of the implants which differentially contain

the beneficial substance to a significantly higher level than adjacent, non-reservoir, regions of the implant.

claim 19
28. A silicon implant according to ~~any one of claims 19 to 27~~ which comprises a first component defining in part a boundary of the or each reservoir and a second component defining in part a boundary of the or each reservoir.

29. A silicon implant according to claim 28 in which the two components are substantially the same.

claim 19
30. A silicon implant according to ~~any one of claims 19 to 29~~ in which there are at least of the order of ten, and preferably at least of the order of a hundred, reservoirs.
B

31. A silicon implant according to claim 30 in which there are at least or the order of a thousand reservoirs.

claim 19
32. A silicon implant according to ~~any one of claims 19 to 31~~ that has been micromachined.

33. An implant comprising a porous or polycrystalline carrier material that is corrode by mammalian subcutaneous physiological fluids, and a beneficial substance associated with the carrier material.

34. An implant *IC* according to claim 33 in which the carrier material is a semiconductor.

cancel

35. An implant according to claim 34 in which the carrier material is from the doped or undoped group: silicon, germanium, silicon carbide, silicon nitride.

36. An implant according to ~~any one of claims 33 to 35~~ in which the implant comprises porous or polycrystalline semiconductor material.

37. An implant according to ~~any one of claims 33 to 36~~ in which the beneficial substance comprises an element of the period table.

38. An implant according to claim 36 in which the element is a micromineral.

39. An implant according to claim 36 and ~~any one of claims 1 to 35~~ in which instead of silicon another semiconductor material comprises the material that is eroded in use.

40. A silicon implant substantially as described herein with reference to Figures 4A to 4C and Figure 5 of the accompanying drawings.

41. A silicon implant substantially as described herein with reference to Figure 6, or Figure 7, or Figure 8, or Figure 9 of the accompanying drawings.

42. A method of making a silicon implant for the delivery of a beneficial substance to a subject, the method comprising taking a body of silicon, forming the silicon into an implantable implant, and introducing a beneficial substance into the silicon.

43. A method according to claim 42 which comprises applying a solution of micromineral to the silicon and migrating the micromineral into the silicon.

44. A method according to claim 42 ~~or claim 43~~ comprising driving the beneficial substance into the silicon using heat.

45. A method according to ~~any one of claims 42 to 44~~ *claim 42* comprising micromachining a hole or recess in the silicon.

46. A method according to claim 45 further comprising introducing said beneficial substance into the hole.

47. A method according to ~~any one of claims 43 to 46~~ *claim 43* comprising applying a lid, or door, over the region which contains the beneficial substance to retain the beneficial substance.

48. A method according to ~~any one of claims 45 to 47~~ *claim 45* comprising making a hole in a first component of silicon, making a complementary hole in a second piece of silicon, introducing said beneficial substance into one or both holes, and joining the two components together with their holes in register to define a closed reservoir which contains said beneficial substance.

49. A method according to ~~any one of claims 45 to 48~~ *claim 45* comprising making a large number of holes in the implant, preferably simultaneously.

50. A method according to claim 49 which uses a photolithographic technique to make the holes.

52. A method according to claim 51 comprising making a body of silicon porous throughout substantially the whole of its volume.

53. A method according to ~~any one of claims 42 to 50~~ comprising taking, or creating, a polycrystalline silicon body of material, or a layer or region of polycrystalline silicon.

54. A method of making a semiconductor implant for the delivery of a beneficial substance to a subject, the method comprising taking a body of semiconductor, forming the semiconductor into an implantable implant, and introducing a beneficial substance into the semiconductor.

55. A method according to claim 54 in which the semiconductor is from the group: silicon, germanium.

56. A method according to claim 54 or claim 55 comprising introducing a micromineral to the semiconductor.

57. A method according to any one of claims 54 to 56 and in accordance with any one of claims 42 to 53, in which the silicon material need not be silicon but could be another semiconductor.

58. A method of making a semiconductor implant substantially as described herein.

59. A method of making an implant for the delivery of beneficial substance to a subject, the method comprising treating a porous member of

material that is erodable in vivo, creating an implant from the member, and introducing a beneficial substance into the implant.

60. An implant having a plurality of reservoirs, a plurality of beneficial substance charges provided in said reservoirs, and a plurality of barrier regions, or doors, provided adjacent said reservoirs, the doors having a plurality of different erosion times when implanted, the arrangement being such that in use the doors are broken down sequentially in order to stagger the release of the contents of the reservoirs.

61. An implant according to claim 60 in which the doors comprise a semiconductor material.

62. An implant according to claim 60 or claim 61 in which substantially the entire implant comprises semiconductor material.

63. An implant according to claim 62 in which the implant comprises the same semiconductor material throughout.

64. An implant according to ^{claim 60} ~~any one of claims 60 to 63~~ in which there are at least five reservoirs.

65. An implant according to claim 64 in which there are at least ten reservoirs.

66. An implant according to claim 64 in which there are at least fifty reservoirs.

67. An implant according to claim 64 in which there are at least one hundred reservoirs.

68. An implant according to claim 64 in which there are at least of the order of hundreds of reservoirs.

69. A method of delivering a beneficial substance to a subject comprising implanting an implant into the subject and arranging for different regions of the implant to be eroded through or away at different times by arranging for said regions to require different exposure times to the corroding fluids experienced in use to be breached, and using the sequential breaching of said different regions to release sequentially different reservoirs of beneficial substance that were retained in or behind said different regions of the implant.

70. The use of corrodable or resorbable silicon, or other semiconductor material, in the preparation of an implant for the delivery of a physiologically active substance to a subject.

71. The use of the corrosion or resorption of silicon or other semiconductor material in an implant in order to release a substance entrained in the material of the silicon or semiconductor, or to open a door to a reservoir of the substance.

72. A silicon implant according to ~~any one of Claims 6, 7, 9, 10, and 11~~ characterised in that the implant comprises a porous silicon sample having a sample surface, the element being present at a concentration between 1 and 90 atomic percent at a depth from the sample surface between 0.35 μ m and 1000 μ m.

73 A silicon implant according to Claim 72 characterised in that the element is present at a concentration between 1 and 50 atomic percent at a depth, from the sample surface, between 0.35 μm and 100 μm .

74 A silicon implant according to Claim 72 characterised in that the element is present at a concentration between 1 and 10 atomic percent at a depth, from the sample surface, between 0.35 μm and 100 μm .

75 A silicon implant according to Claim 72 characterised in that the element is present at a concentration between 1 and 10 atomic percent at a depth, from the sample surface, between 20 μm and 30 μm .

76 A method according to Claim 54 characterised in that the method comprises the further step of treating the body of semiconductor to make at least part of it porous.

77 A method according to Claim 76 characterised in that the step of introducing the beneficial substance comprises the steps:

- (a) bringing the beneficial substance into contact with the porous part of the semiconductor;
- (b) causing the beneficial substance to be in a molten phase; and
- (c) allowing the molten beneficial substance to pass into the porous part of the semiconductor.

78 A method according to Claim 77 characterised in that the passage of the beneficial substance into the porous semiconductor is assisted by the application of heat to the porous semiconductor.

79 A method according to Claim 77 characterised in that the method further comprises the step of thermally decomposing the beneficial substance that has passed into the porous semiconducting material.

80 A method according to Claim 77 characterised in that the method comprises the step of reacting the beneficial substance that has passed into the semiconductor material with an oxidant.

Claim 76
81 A method according to ~~any one of Claims 76 to 80~~ characterised in that the semiconductor is silicon.

82 A method of impregnating a porous semiconducting material with an impregnate substance, the method comprising the step of bringing the impregnate substance into contact with the porous semiconducting material; characterised in that the method further comprises the steps:

- (a) causing the impregnate substance to be in a molten phase; and
- (b) allowing the molten impregnate substance to pass into the porous semiconducting material.

83 A method according to Claim 82 characterised in that the passage of the impregnate substance into the porous semiconductor is assisted by the application of heat to the porous semiconductor.

84 A method according to Claim 82 characterised in that the method further comprises the step of thermally decomposing the impregnate substance that has passed into the porous semiconducting material.

85 A method according to Claim 82 characterised in that the method comprises the step of reacting the impregnate substance that has passed into the semiconductor material with an oxidant.

claim 82
86 A method according to ~~any one of Claims 82 to 85~~ characterised in that the impregnate substance comprises a metal salt.

87 A method according to Claim 86 characterised in that the impregnate substance comprises two or more metal salts.

88 A method according to Claim 86 characterised in that the metal salt is manganese nitrate or chromium nitrate or silver nitrate or calcium nitrate.

89 A method according to Claim 86 characterised in that the metal salt is a salt of one or more the transition metals or the rare earth metals.

90 A method according to Claim 86 characterised in that the salt is a nitrate or an alkoxide or a beta-diketone, or a mixed alkoxide/beta-diketone.

91 A method according to Claim 86 characterised in that the salt has a melting point less than 800 C.

92 A method according to Claim 86 characterised in that the salt has a melting point less than 400 C.

93 A method according to Claim 86 characterised in that the salt has a melting point between 0 C and 150 C.

claim 82
94 A method according to ~~any one of Claims 82 to 93~~ characterised in that the porous semiconducting material is porous silicon.

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of porous silicon that has been impregnated with a metal element, the sample having a sample thickness comprising an impregnated element at a concentration of between 1 and 50 at a depth, from the sample surface, between 0.35 μm and 100 μm , according to Claim 96 characterised in that the impregnated element is present at a concentration between 1 and 10 at a depth, from the sample surface, between 0.35 μm and 100 μm , according to Claim 96 characterised in that the impregnated element is present at a concentration between 1 and 10 at a depth, from the sample surface, between 20 μm and 30 μm .

Claim 96

according to any one of Claims 96 to 99, wherein the impregnated element comprises a metal.

according to Claim 100 characterised in that the impregnated element is silver, gold, platinum, palladium, niobium, titanium, zirconium, hafnium, niobium, silver or calcium.

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~~Claim 26~~
~~any one of Claims 1-25~~

~~Claim 26~~
~~any one of Claims 1-25~~

of porous silicon that has been impregnated with a metal element, the sample having a sample thickness comprising an impregnated element at a concentration of between 1 and 50 at a depth, from the sample surface, between 0.35 μm and 100 μm , according to Claim 96 characterised in that the impregnated element is present at a concentration between 1 and 10 at a depth, from the sample surface, between 0.35 μm and 100 μm , according to Claim 96 characterised in that the impregnated element is present at a concentration between 1 and 10 at a depth, from the sample surface, between 20 μm and 30 μm .

Claim 96

according to any one of Claims 96 to 99, wherein the impregnated element comprises a metal.

according to Claim 100 characterised in that the impregnated element is silver, gold, platinum, palladium, niobium, titanium, zirconium, hafnium, niobium, silver or calcium.

102 A sample according to ~~Claim~~ ^{claim 77} 100 characterised in that the metal is a transition metal or a rare earth metal

103 A method according to ~~any one of Claims 77 to 81~~ ^{claim 77} characterised in that the beneficial substance substantially consists of a metal salt.

104 A method according to ~~any one of Claims 77 to 81~~ ^{claim 77} characterised in that the beneficial substance substantially consists of a mixture of two or more metal salts.

105 A method according to ~~any one of Claims 77 to 81~~ ^{claim 77} characterised in that the beneficial substance is a solid at 293 K and 760 mmHg.



106 A method according to ~~any one of Claims 82 to 86~~ ^{claim 82} or any one of Claims 88 to 93 characterised in that the impregnate substance substantially consists of a metal salt.

107 A method according to any one of Claims 87 characterised in that the impregnate substance substantially consists of a mixture of two or more metal salts.

108 A method according to ~~any one of Claims 82 to 85~~ ^{claim 82} characterised in that the impregnate substance is a solid at 293 K and 760 mmHg.

109 A silicon implant according to ~~Claim~~ ^{claim 73} 73 characterised in that the element is present at a concentration between 1 and 50 atomic percent at a depth, from the sample surface, between 10 μm and 100 μm .

112 A sample according to Claim 98 characterised in that the impregnate element is present at a concentration between 1 and 10 atomic percent at a depth, from the sample surface, between 10 μm and 100 μm .

11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044